Express Mail Label No. _____ Dated: _____

Docket No.: 20154/0204182-US0
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Koichiro Morimoto et al.

Application No.: National Phase of PCT/JP2004/014244

Confirmation No.: N/A

Filed: Concurrently Herewith

Art Unit: N/A

For: VALVE SEAT FOR ENGINE (AS AMENDED)

Examiner: Not Yet Assigned

FIRST PRELIMINARY AMENDMENT

MS PCT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

INTRODUCTORY COMMENTS

Prior to examination on the merits, please amend the above-identified U.S. patent application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Abstract begin on page 3 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 4 of this paper.

Remarks/Arguments begin on page 6 of this paper.

AMENDMENTS TO THE SPECIFICATION

Substitute Specification

Please find attached a marked-up copy and a clean copy of the substitute specification. No new matter has been added. Kindly replace the specification with the clean substitute specification attached.

AMENDMENTS TO THE ABSTRACT

Please substitute the following paragraph(s) for the abstract now appearing in the currently filed specification:

--A Fe-based valve seat that is provided in a seat-mounting portion at an inlet of a cylinder head formed by aluminum alloy is made of a Fe-Al-based material. The Fe-Al-based material contains Al in the range of 15 to 23% by weight. Galvanic corrosion is prevented by decreasing a potential difference between the seat-mounting portion of the cylinder head and the valve seat as much as possible.--

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A valve seat for an engine,

wherein the valve seat ~~that is~~ provided in a seat-mounting portion at an inlet or outlet of a cylinder head formed of an aluminum alloy is made of a Fe-Al-based material.

Claim 2 (original): The valve seat for an engine according to claim 1,

wherein the Fe-Al-based material is a sintered material.

Claim 3 (currently amended): The valve seat for an engine according to claim 1 ~~or 2~~,

wherein the Fe-Al-based material is a sintered material containing Fe-Al alloy powder.

Claim 4 (currently amended): The valve seat for an engine according to ~~any one of~~ claims 1 ~~to 3~~,

wherein the Fe-Al-based material contains Al in the range of 15 to 23% by weight.

Claim 5 (new): The valve seat for an engine according to claim 2,

wherein the Fe-Al-based material is a sintered material containing Fe-Al alloy powder.

Claim 6 (new): The valve seat for an engine according to claim 2,

wherein the Fe-Al-based material contains Al in the range of 15 to 23% by weight.

Claim 7 (new): The valve seat for an engine according to claim 3,

wherein the Fe-Al-based material contains Al in the range of 15 to 23% by weight.

REMARKS

The title has been amended to be in conformance with the English translation of the International Application.

The specification is amended in accordance with 37 CFR §1.78 to make reference to the International Application from which this application originates and to incorporate by reference the Japanese priority applications. Also the specification is amended to conform to U.S. practice. A marked-up copy and a clean copy of the substitute specification are provided.

Claims 3 and 4 have been amended to eliminate multiply dependency. Claims 5-7 have been added to restore the subject matters that was removed as a result of the amendment and to further claim what the applicants regard as the invention. New claims are fully supported by the original claims and the specification. The amendment is made to reduce filing fees and not for any other reason related to patentability of such claims.

Abstract has been amended to conform to U.S. practice.

No new matter has been added by these amendments.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Dated: March 30, 2006

Respectfully submitted,

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Marked-Up Copy of Substitute Specification

DESCRIPTION

VALVE SEAT FOR ENGINE

Cross-Reference to Prior Application

This application is a U.S. national phase application under 35 U.S.C. §371 of International Patent Application No. PCT/JP2004/014244, filed September 29, 2004, and claims the benefit of Japanese Application No. 2003-341540, filed September 30, 2003, both of which are incorporated by reference herein. The International Application was published in Japanese on April 7, 2005 as International Publication No. WO 2005/031125 under PCT Article 21(2).

Technical Field

The present invention relates to a valve seat for an engine.

Background Art

Conventionally, as a valve seat for an engine, a valve seat made of an iron-based sintered alloy is known in the related art. For example, the valve seat is made of an Fe-based sintered alloy which has an overall composition consisting of, by weight, 0.7 to 1.4% C, 0.2 to 0.9% Si, 15.1 to 26% Co, 6.1 to 11% Mo, 2.6 to 4.7% Cr, 0.5 to 1.2%

Ni, 0.2 to 0.7% Nb, and the remaining balance of Fe are inevitable impurities, in which case hard grains of a Co-based alloy consisting of Co-Mo-Cr-based alloy are dispersedly distributed in a ratio of 10 to 24% by area with 5 to 15% porosity when observed on the photograph of a structure under an optical microscope. The valve seat has wear resistance (see JP-A-11-209855 (paragraph 0004)).

~~Disclosure~~ Summary of the Invention

~~Problems to be Solved by the Invention~~

Recently, there has been supplied an engine fuel mainly containing alcohol so as to exhaust relatively clean gas. The fuel enters a combustion chamber with air through an inlet, and is in turn burned after an intake valve seat provided at the inlet is closed by an intake valve, thereby generating power. An exhaust valve seat provided at an outlet is then opened by an exhaust valve and exhaust gas is discharged.

Meanwhile, in the engine fuel mainly containing alcohol, the fuel may contain a lot of water, as compared to conventional fuel, such as gasoline and ~~gas~~ diesel oil. For this reason, when the fuel mainly containing alcohol enters a cylinder with air through the inlet having the intake valve seat provided therein, the water may possibly seep through a gap between the intake valve seat and a seat-

mounting portion of a cylinder head on which the valve seat is mounted. In this configuration, when the intake valve seat and the seat-mounting portion are made of different metals, for example, when the intake valve seat is made of an iron-based metal and the seat-mounting portion, i.e. the cylinder head is made of an aluminum-based metal, galvanic corrosion may occur due to the remaining water in the gap between the intake valve seat and the seat-mounting portion. In other words, galvanic corrosion means corrosion of a metal which has negative polarity, resulting from generation of electricity when two different metals are in contact with each other due to the existence of water between them. In the case of an aluminum and iron, the aluminum has negative polarity and corrodes. In this regard, a hole from the seat-mounting portion to the coolant passage may form due to galvanic corrosion.

Galvanic corrosion may also occur in a seat-mounting portion at an outlet and exhaust valve seat.

It is an object of the invention to provide a valve seat for an engine which is provided in a seat-mounting portion provided at an inlet or outlet of a cylinder head formed by an aluminum alloy and has resistance to galvanic corrosion.

~~Means for Solving the Problems~~

~~According to a first aspect of the invention, a valve seat for an engine provided in a seat mounting portion at an inlet or outlet of a cylinder head formed by an aluminum alloy is made of Fe-Al based material.~~

~~According to a second aspect of the invention, the Fe-Al based material is a sintered material.~~

~~According to a third aspect of the invention, the Fe-Al based material is a sintered material containing Fe-Al alloy powder.~~

~~According to a fourth aspect of the invention, the Fe-Al based material contains Al in the range of 15 to 26% by weight.~~

~~Effects of the Invention~~

~~According to the first aspect of the invention, the potential difference can decrease between the valve seat and the cylinder head formed by an aluminum alloy, therefore, the potential difference through the water between the seat mounting portion and the cylinder head can decrease and galvanic corrosion can be prevented.~~

~~According to the second aspect of the invention, a variety of Fe-Al based materials are available for the invention.~~

~~According to the third aspect of the invention, Fe-Al oxidizes at a working temperature of the valve seat and~~

~~adhesive wear can be prevented, thereby achieving excellent wear resistance.~~

~~According to the fourth aspect of the invention, galvanic corrosion can be prevented by decreasing the potential difference from the cylinder head as much as possible.~~

Brief Description of the Drawings

Fig. 1 is a cross-sectional view according to ~~a first~~ an embodiment of the invention,

Fig. 2 is a view showing a metallic structure according to the ~~first~~ embodiment of the invention, and

Fig. 3 is a graph showing a potential difference according to the ~~first~~ above embodiment of the invention.

~~Reference Numerals~~

~~2 CYLINDER HEAD~~

~~6 INLET~~

~~• VALVE SEAT~~

~~Best Mode for Carrying Out~~ Detailed Description of the Invention

Hereinafter, a preferred embodiment of the present invention will be described with reference to the accompanying drawings. The application of the invention is not limited to the present embodiment. In addition, not all

of the following configurations are essential in the invention. For example, even though the following embodiment is applied to an inlet, it is also applicable to a seat-mounting portion at an outlet and exhaust valve seat.

~~First Embodiment~~

According to a first aspect of the invention, a valve seat for an engine provided in a seat-mounting portion at an inlet or outlet of a cylinder head formed by an aluminum alloy is made of Fe-Al-based material.

According to a second aspect of the invention, the Fe-Al-based material is a sintered material.

According to a third aspect of the invention, the Fe-Al-based material is a sintered material containing Fe-Al alloy powder.

According to a fourth aspect of the invention, the Fe-Al-based material contains Al in the range of 15 to 26% by weight.

According to the first aspect of the invention, the potential difference can decrease between the valve seat and the cylinder head formed by an aluminum alloy, therefore, the potential difference through the water between the seat-mounting portion and the cylinder head can decrease and galvanic corrosion can be prevented.

According to the second aspect of the invention, a variety of Fe-Al-based materials are available for the invention.

According to the third aspect of the invention, Fe-Al oxidizes at a working temperature of the valve seat and adhesive wear can be prevented, thereby achieving excellent wear resistance.

According to the fourth aspect of the invention, galvanic corrosion can be prevented by decreasing the potential difference from the cylinder head as much as possible.

Example 1

Figs. 1 to 3 show ~~a first~~ an embodiment. Made of an aluminum alloy, a cylinder head 2 is fixed onto a cylinder 1 in which a piston (not shown) reciprocates. An intake port 3 and exhaust port 4 are provided to both sides of the cylinder head, respectively. In the intake port 3, an intake valve seat 7 is provided at an inlet 6 communicating with a combustion chamber 5, and is opened and closed by means of an intake valve 8. Similarly, in the exhaust port 4, an exhaust valve seat 10 is provided at an outlet 9 communicating with the combustion chamber 5, and is opened and closed by means of an exhaust valve 11. In addition, the cylinder head 2 is provided with a coolant passage 12

between the exhaust port 3 and the intake port 4.

A seat-mounting portion 13 for mounting the intake valve seat 7 therein is provided at the inlet 6. The seat-mounting portion 13 is formed in a U-shape having a slightly larger diameter than the intake port 3, and the intake valve seat 7 is fitted into the seat-mounting portion 13. In addition, reference numeral '14' refers to a seat surface coming into contact with and separating from the intake valve 8 when opening and closing, and '15' refers to an inner peripheral surface of the intake valve seat 7.

The intake valve seat 7 is a ring-shape part made by forming Fe-Al-based powder and sintering it thereafter, of which the inner and outer diameters are the same as the diameters of the seat-mounting portion 13 and the intake port 3, respectively.

Next, a manufacturing method of the intake valve seat 7 is described. For example, after preparing reducing iron powder of 150 mesh, aluminum powder of 150 mesh containing Fe of 50% by weight, carbon powder(C) having average grain size of 10 μm, and binder, they were blended in a predetermined ratio. The resulting mixed powder was subjected to a metallic molding under 7 ton/cm^2 pressure, thereby forming a ring-shaped green compact. The green compact was subjected to a heat-degreasing process in a vacuum, thereafter, sintered at 1200℃ for an hour, thereby

obtaining a sintered compact. As shown in the metallographic structure of Fig. 2, the size of the Fe-Al alloy was 500 μm or less, preferably 300 μm or less. A valve seat having 36 mm outer diameter, 30 mm inner diameter, 6 mm thickness, and 1.5 mm seat surface width, was formed from the sintered compact.

The Fe-Al-based material forming the valve seat 7 contains Al in the range of 15 to 23% by weight. As shown in the graph illustrating potential differences depending on Al by weight, in the case of Al ranging from 15 to 26 % by weight, the potential difference may be decreased by means of Fe_3Al generation.

Hereinafter, the operation according to the above-mentioned configuration will be described. When engine fuel mainly containing alcohol and a relatively large amount of water enters the cylinder 1 with air through the intake port, in the case where water seeps through and remains in a gap s between the intake valve seat 7 and the seat-mounting portion 13, and due to the cylinder head 2 and the intake valve 7 being in contact with through the water, galvanic corrosion may occur because of the different metals contacting each other. The intake valve seat 7~~10~~, however, is made of a material having slight potential difference from the cylinder head 2 formed of aluminum alloy. Therefore, unlike when different metals are in a contacting

state, electricity is not generated between them even if water seeps through the gap, thus preventing galvanic corrosion.

As described above, in the above embodiment, because the valve seat 10 that is provided in the seat-mounting portion 13 provided at the inlet 6 of the cylinder head 2 formed by aluminum alloy is made of Fe-Al-based material instead of Fe-based, the cylinder head 2 and the valve seat 10 are in a like-metal-contact relationship and the potential difference resulting from different-metal-contact decreases between the seat-mounting portion 13 and the valve seat 10, thus preventing galvanic corrosion.

Further, since the Fe-Al-based material forming the valve seat 10 contains Fe-Al alloy powder, the Fe-Al alloy powder oxidizes at a working temperature of the valve seat 10, thus preventing adhesion of the valve seat 10 during fuel combustion and achieving improved wear resistance.

Also, the Fe-Al-based material contains Al in the range of 15 to 26% by weight, therefore, the potential difference is decreased as much as possible due to the generation of Fe_3Al and the potential difference resulting from the different-metal-contact between the seat-mounting portion 13 and the valve seat 10, furthermore, between the cylinder head 2 formed by aluminum alloy and the valve seat 10 decreases as much as possible, as a result, galvanic

corrosion may be prevented.

~~Industrial Applicability~~

The valve seat according to the present invention, as describe above, is applicable to the engine fuel containing a relatively large amount of water.

ABSTRACT

~~It is an object to provide a valve seat for an engine which is provided in a seat-mounting portion provided at an inlet or outlet of a cylinder head formed by an aluminum alloy and has resistance to galvanic corrosion.~~

A Fe-based valve seat ~~10~~ that is provided in a seat-mounting portion at an inlet ~~6~~ of a cylinder head ~~2~~ formed by aluminum alloy is made of a Fe-Al-based material. The Fe-Al-based material contains Al in the range of 15 to 23% by weight. Galvanic corrosion is prevented by decreasing a potential difference between the seat-mounting portion ~~13~~ of the cylinder head ~~2~~ and the valve seat ~~2~~ as much as possible.

Clean Copy of Substitute Specification

DESCRIPTION

VALVE SEAT FOR ENGINE

Cross-Reference to Prior Application

This application is a U.S. national phase application under 35 U.S.C. §371 of International Patent Application No. PCT/JP2004/014244, filed September 29, 2004, and claims the benefit of Japanese Application No. 2003-341540, filed September 30, 2003, both of which are incorporated by reference herein. The International Application was published in Japanese on April 7, 2005 as International Publication No. WO 2005/031125 under PCT Article 21(2).

Technical Field

The present invention relates to a valve seat for an engine.

Background Art

Conventionally, as a valve seat for an engine, a valve seat made of an iron-based sintered alloy is known in the related art. For example, the valve seat is made of an Fe-based sintered alloy which has an overall composition consisting of, by weight, 0.7 to 1.4% C, 0.2 to 0.9% Si, 15.1 to 26% Co, 6.1 to 11% Mo, 2.6 to 4.7% Cr, 0.5 to 1.2%

Ni, 0.2 to 0.7% Nb, and the remaining balance of Fe are inevitable impurities, in which case hard grains of a Co-based alloy consisting of Co-Mo-Cr-based alloy are dispersedly distributed in a ratio of 10 to 24% by area with 5 to 15% porosity when observed on the photograph of a structure under an optical microscope. The valve seat has wear resistance (see JP-A-11-209855 (paragraph 0004)).

Summary of the Invention

Recently, there has been supplied an engine fuel mainly containing alcohol so as to exhaust relatively clean gas. The fuel enters a combustion chamber with air through an inlet, and is in turn burned after an intake valve seat provided at the inlet is closed by an intake valve, thereby generating power. An exhaust valve seat provided at an outlet is then opened by an exhaust valve and exhaust gas is discharged.

Meanwhile, in the engine fuel mainly containing alcohol, the fuel may contain a lot of water, as compared to conventional fuel, such as gasoline and diesel oil. For this reason, when the fuel mainly containing alcohol enters a cylinder with air through the inlet having the intake valve seat provided therein, the water may possibly seep through a gap between the intake valve seat and a seat-mounting portion of a cylinder head on which the valve seat

is mounted. In this configuration, when the intake valve seat and the seat-mounting portion are made of different metals, for example, when the intake valve seat is made of an iron-based metal and the seat-mounting portion, i.e. the cylinder head is made of an aluminum-based metal, galvanic corrosion may occur due to the remaining water in the gap between the intake valve seat and the seat-mounting portion. In other words, galvanic corrosion means corrosion of a metal which has negative polarity, resulting from generation of electricity when two different metals are in contact with each other due to the existence of water between them. In the case of an aluminum and iron, the aluminum has negative polarity and corrodes. In this regard, a hole from the seat-mounting portion to the coolant passage may form due to galvanic corrosion.

Galvanic corrosion may also occur in a seat-mounting portion at an outlet and exhaust valve seat.

It is an object of the invention to provide a valve seat for an engine which is provided in a seat-mounting portion provided at an inlet or outlet of a cylinder head formed by an aluminum alloy and has resistance to galvanic corrosion.

Brief Description of the Drawings

Fig. 1 is a cross-sectional view according to an

embodiment of the invention,

Fig. 2 is a view showing a metallic structure according to the embodiment of the invention, and

Fig. 3 is a graph showing a potential difference according to the above embodiment of the invention.

Detailed Description of the Invention

Hereinafter, a preferred embodiment of the present invention will be described with reference to the accompanying drawings. The application of the invention is not limited to the present embodiment. In addition, not all of the following configurations are essential in the invention. For example, even though the following embodiment is applied to an inlet, it is also applicable to a seat-mounting portion at an outlet and exhaust valve seat.

According to a first aspect of the invention, a valve seat for an engine provided in a seat-mounting portion at an inlet or outlet of a cylinder head formed by an aluminum alloy is made of Fe-Al-based material.

According to a second aspect of the invention, the Fe-Al-based material is a sintered material.

According to a third aspect of the invention, the Fe-Al-based material is a sintered material containing Fe-Al alloy powder.

According to a fourth aspect of the invention, the Fe-

Al-based material contains Al in the range of 15 to 26% by weight.

According to the first aspect of the invention, the potential difference can decrease between the valve seat and the cylinder head formed by an aluminum alloy, therefore, the potential difference through the water between the seat-mounting portion and the cylinder head can decrease and galvanic corrosion can be prevented.

According to the second aspect of the invention, a variety of Fe-Al-based materials are available for the invention.

According to the third aspect of the invention, Fe-Al oxidizes at a working temperature of the valve seat and adhesive wear can be prevented, thereby achieving excellent wear resistance.

According to the fourth aspect of the invention, galvanic corrosion can be prevented by decreasing the potential difference from the cylinder head as much as possible.

Example 1

Figs. 1 to 3 show an embodiment. Made of an aluminum alloy, a cylinder head 2 is fixed onto a cylinder 1 in which a piston (not shown) reciprocates. An intake port 3 and exhaust port 4 are provided to both sides of the cylinder

head, respectively. In the intake port 3, an intake valve seat 7 is provided at an inlet 6 communicating with a combustion chamber 5, and is opened and closed by means of an intake valve 8. Similarly, in the exhaust port 4, an exhaust valve seat 10 is provided at an outlet 9 communicating with the combustion chamber 5, and is opened and closed by means of an exhaust valve 11. In addition, the cylinder head 2 is provided with a coolant passage 12 between the exhaust port 3 and the intake port 4.

A seat-mounting portion 13 for mounting the intake valve seat 7 therein is provided at the inlet 6. The seat-mounting portion 13 is formed in a U-shape having a slightly larger diameter than the intake port 3, and the intake valve seat 7 is fitted into the seat-mounting portion 13. In addition, reference numeral '14' refers to a seat surface coming into contact with and separating from the intake valve 8 when opening and closing, and '15' refers to an inner peripheral surface of the intake valve seat 7.

The intake valve seat 7 is a ring-shape part made by forming Fe-Al-based powder and sintering it thereafter, of which the inner and outer diameters are the same as the diameters of the seat-mounting portion 13 and the intake port 3, respectively.

Next, a manufacturing method of the intake valve seat 7 is described. For example, after preparing reducing iron

powder of 150 mesh, aluminum powder of 150 mesh containing Fe of 50% by weight, carbon powder(C) having average grain size of 10 μm, and binder, they were blended in a predetermined ratio. The resulting mixed powder was subjected to a metallic molding under 7 ton/cm^2 pressure, thereby forming a ring-shaped green compact. The green compact was subjected to a heat-degreasing process in a vacuum, thereafter, sintered at 1200℃ for an hour, thereby obtaining a sintered compact. As shown in the metallographic structure of Fig. 2, the size of the Fe-Al alloy was 500 μm or less, preferably 300 μm or less. A valve seat having 36 mm outer diameter, 30 mm inner diameter, 6 mm thickness, and 1.5 mm seat surface width, was formed from the sintered compact.

The Fe-Al-based material forming the valve seat 7 contains Al in the range of 15 to 23% by weight. As shown in the graph illustrating potential differences depending on Al by weight, in the case of Al ranging from 15 to 26 % by weight, the potential difference may be decreased by means of Fe_3Al generation.

Hereinafter, the operation according to the above-mentioned configuration will be described. When engine fuel mainly containing alcohol and a relatively large amount of water enters the cylinder 1 with air through the intake port, in the case where water seeps through and remains in a gap s

between the intake valve seat 7 and the seat-mounting portion 13, and due to the cylinder head 2 and the intake valve 7 being in contact with through the water, galvanic corrosion may occur because of the different metals contacting each other. The intake valve seat 7, however, is made of a material having slight potential difference from the cylinder head 2 formed of aluminum alloy. Therefore, unlike when different metals are in a contacting state, electricity is not generated between them even if water seeps through the gap, thus preventing galvanic corrosion.

As described above, in the above embodiment, because the valve seat 10 that is provided in the seat-mounting portion 13 provided at the inlet 6 of the cylinder head 2 formed by aluminum alloy is made of Fe-Al-based material instead of Fe-based, the cylinder head 2 and the valve seat 10 are in a like-metal-contact relationship and the potential difference resulting from different-metal-contact decreases between the seat-mounting portion 13 and the valve seat 10, thus preventing galvanic corrosion.

Further, since the Fe-Al-based material forming the valve seat 10 contains Fe-Al alloy powder, the Fe-Al alloy powder oxidizes at a working temperature of the valve seat 10, thus preventing adhesion of the valve seat 10 during fuel combustion and achieving improved wear resistance.

Also, the Fe-Al-based material contains Al in the range

of 15 to 26% by weight, therefore, the potential difference is decreased as much as possible due to the generation of Fe_3Al and the potential difference resulting from the different-metal-contact between the seat-mounting portion 13 and the valve seat 10, furthermore, between the cylinder head 2 formed by aluminum alloy and the valve seat 10 decreases as much as possible, as a result, galvanic corrosion may be prevented.

The valve seat according to the present invention, as describe above, is applicable to the engine fuel containing a relatively large amount of water.

ABSTRACT

A Fe-based valve seat that is provided in a seat-mounting portion at an inlet of a cylinder head formed by aluminum alloy is made of a Fe-Al-based material. The Fe-Al-based material contains Al in the range of 15 to 23% by weight. Galvanic corrosion is prevented by decreasing a potential difference between the seat-mounting portion of the cylinder head and the valve seat as much as possible.